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STUDY PROJECT

COMMAND, CONTROL, AND COMMUNICATIONS (C3)
THROUGH TEST AND EVALUATION

BY

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United States Army

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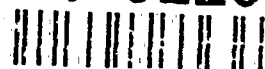
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This study looks at the problem of C^3 Interoperability within DOD today and assesses the impact that test and evaluation programs may have in assuring C^3 systems interoperate. The history of C^3 interoperability begins in Vietnam but becomes a central U.S. government issue in the review of the Grenada invasion. Congress was so incensed they passed the Goldwater-Nichols act mandating "jointness." Over time this joint development of the DOD may solve C^3 interoperability, but in the present and near future our problems are

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enormous. A certification program for C^3 systems is the surest method of arriving at near term interoperability. This certification process features a test and evaluation program encompassing traditional testing and evaluation of joint exericses. Future systems have requirements for interoperability that must be resolved before full scale development occurs. Robotics, space systems and battle simulations are but a few of the systems needing inter-operability standards for joint development. We must attack our service parochialism and strive for joint C^3 systems that can function on a moment's notice anywhere in the world.

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COMMAND,   CONTROL,   AND COMMUNICATIONS   (C3) THROUGH   TEST   AND   EVALUATION

AN INDIVIDUAL STUDY PROJECT

by

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ABSTRACT

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This study looks at the problem of C^3 Interoperability within DOD today and assesses the impact that test and evaluation programs may have in assuring C^3 systems interoperate. The history of C^3 interoperability begins in Vietnam but becomes a central U.S. government issue in the review of the Grenada invasion. Congress was so incensed they passed the Goldwater-Nichols act mandating "jointness." Over time this joint development of the DOD may solve C^3 interoperability, but in the present and near future our problems are enormous. A certification program for C^3 systems is the surest method of arriving at near term interoperability. This certification process features a test and evaluation program encompassing traditional testing and evaluation of joint exercises. Future systems have requirements for interoperability that must be resolved before full scale development occurs. Robotics, space systems and battle simulations are but a few of the systems needing interoperability standards for joint development. We must attack our service parochialism and strive for joint C^3 systems that can function on a moments notice anywhere in the world.

INTRODUCTION

During the 1980's, the United States military invested billions of dollars in personnel and equipment to prepare for the eventuality of war. As Operation Desert Storm demonstrated, many of these new weapons and the servicemen performed magnificently. However, the war had some very favorable characteristics. The six months available for planning, rehearsals, and corrections resulted in a very predictable, carefully planned and sequential campaign. The enemy fought on our terms and failed to break or disturb our planning and execution cycle, so our command and control systems functioned in an unstressed environment. What if Desert Storm required immediate combat operations, encompassing a simultaneous ground, air and sea battle? Would our command and control systems have been adequate? Most experts say no. Vietnam, Iran, the _Mayaguez_, Grenada and Libya operations all suggest the experts are probably correct: in Desert Storm our communications systems would have failed because we still have not solved our interoperability problems. In 1989, Senator Sam Nunn wrote:

> "The United States will never send forces from just a single
> military service to major combat in the future. All future major
> combat operations will combine the capabilities of each of the
> military departments under the joint combatant commanders.
> Technical and procedural interoperability in command and control
> has become a real imperative. Modern communications and computer

technology, if properly managed, can help to bridge the interoperability gap. However, this gap will surely widen if we fail to emphasize interoperability in managing our investment in modern command and control systems."[1]

While the Department of Defense (DOD) struggled with command, control and communications (C^3) interoperability issues, the United States Congress increased their interest in DOD's progress. Congress' strongest action was to pass the Defense Reorganization Act of 1986 (also known as Goldwater-Nichols). This law attempted to force more joint cooperation between the services and to make the CINC's (Commanders-in-Chief of our joint combatant commands such as the Central Command or CENTCOM in Saudi Arabia) more of a player in the definition of requirements for new combat systems. Most experts agree on the importance of this legislation but also predict the effects of the act will not be seen in the near term. The problems detracting from jointness are the same detractors from interoperability. While we wait for a true joint spirit to develop and a generation of officers who understand and ascribe to jointness, DOD must overcome today's C^3 interoperability problems. According to the U.S. Government Accounting Office and others, the most effective method of ensuring interoperability is for the services to certify to the Chairman of the Joint Chiefs of Staff their C^3 system will interoperate with other C^3 equipment in a joint environment. Until certified, procurement funds should be withheld.[2,3,4] A single point of enforcement with a budgetary hammer is an

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attractive solution but utopian in nature. Meaningful reform will not occur unless mandated by Congress, and to preclude more Congressional supervision, the DOD should implement a tough certification program.

The certification tool for C^3 interoperability is a test and evaluation program. How should DOD implement a certification program? Centralized or decentralized? How close are we in achieving the goal of joint interoperability? This study will provide answers to these questions and determine how test and evaluation can improve and expand to promote C^3 interoperability for current and future C^3 systems. We will also examine the future of C^3 interoperability to determine how the test and evaluation programs must assess the interoperability of future C^3.

ASSUMPTIONS AND LIMITATIONS

This study will review the broad scope of C^3 interoperability issues to demonstrate the size of the challenge, but it will remain focused on how test and evaluation brings all the issues together for a joint certification. This paper will not be a technical examination of C^3 interoperability, but a critical examination of the effects test and evaluation can have on the problem. We will focus on joint service interoperability while remaining aware of the need to interoperate in the multinational environment. We will also focus our study on C^3 and discuss computers and intelligence (C^4I) only when they interface with the C^3 systems. For example, they must

interoperate over a communications network in order to support command and control.

PROBLEM RECOGNITION

C^3 interoperability has been a military problem for several decades. In the past the weaknesses were in command and control. Because of the smaller dimensions of the battlefield, communications interoperability was not a problem before electronics. We began to see interoperability challenges during the World Wars when coalition warfare became a necessity. C^3 weaknesses emerged when joint service warfare mixed air and sea power with land operations. But the slower the military moved toward solutions, the faster technology developed to make interoperability a persistent problem. The Vietnam War provides a clear example of poor C^3 interoperability. Fighter pilots delivering close air support, equipped with ultra-high frequency (UHF) radios could not communicate directly to the ground forces equipped with very-high-frequency (VHF) radios. Unresponsive air support became the product of jury-rigged solutions.[5]

The Iran hostage rescue mission is an example of C^3 interoperability failing from both the technical and operational aspects. Technically, the helicopter force could not communicate (due to an interoperability failure) with the Desert One ground site. This horizontal (unit-to-unit) communication link was absent even though the vertical (headquarters to headquarters) communication channels reliably communicated from the President

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of the United States to the lowest unit. Operationally, the
forces trained separately and had few joint training exercises
prior to the actual mission. More joint exercises could have
identified the communication gaps and would have allowed
corrections, possibly saving the mission from failure.[5]

Next, one of the more successful military operations (it
accomplished the mission) was also one of the biggest C^3 failures
in recent times. The Grenada invasion received so much negative
publicity that the C^3 problems became larger than reality.
Instead of the lessons learned fading away, Congress seized the
opportunity to influence the military services resulting in the
Goldwater-Nichols Act of 1986. The communications problems in
Grenada were not technical but command and control procedures and
policy problems.[7]   The Rangers and Marines could not
communicate even while on converging axes because of
uncoordinated radio frequencies . Also, an 82d Airborne soldier
called over a commercial, long-distance telephone to Fort Bragg,
NC to request C-130 gunship support. This call became a well
publicized event, especially when the positive answer returned to
Grenada over satellite. Reasons for these failures are numerous,
but the cause is a lack of "jointness". "Jointness" is a new
word meant to imply the characteristic of working together as
military services to accomplish a greater goal than can a single
service acting independently. Grenada required quick reaction by
all services, leaving insufficient time to rehearse and discover
the interoperability problems. The services did not have joint

procedures or sufficient joint training to orchestrate a no-notice joint military operation.[2] Corrections of many of these problems during the Libyan operation ensured a very successful mission.

The Libyan Raid on 15-17 April 1986, consisted of a series of air strikes against ground targets in Libya in response to terrorist attacks against the U.S. This time the services had adequate time to resolve C^3 interoperability problems through the use of the deliberate planning sequence. If this operation required a quick reaction mission, its success would have been doubtful. Joint forces capable of a fast and interoperable reaction are a necessity..[3]

DEFINITIONS
(Also see the Glossary, Appendix A)

What is interoperability and more significantly, what isn't interoperability? JCS Pub 1 defines interoperability as:

> The condition achieved among communications-electronics equipment when information or services can be exchanged directly and satisfactorily between them and/or their users.[4]

Note the definition specifies the measure of effectiveness of interoperability as the satisfactory exchange of information. The definition does not mean the equipment is the same (interchangeability) or completely equal in terms of parts, mounts, etc. (commonality), or completely compatible. If a system met all these characteristics (interchangeable, common, and compatible) then it would be "standardized". A system is "compatible" if it meets the following definition: "the

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capability of two or more items or components of equipment or material to exist or function in the same system or environment without mutual interference." [11]

Compatibility and interoperability causes confusion when used synonymously. Within one service C^3 systems are usually compatible and likewise interoperable, but the same systems can be interoperable in the joint environment but not necessarily compatible. This distinction is important because we must avoid overdesign of the system for compatibility when the desired characteristic is interoperability. An "interface" exists where two systems join to interoperate . As we design, build and test C^3 systems, we should define the interfaces by using C^3 "architectures". An "architecture" shows the command and control (C^2) elements (the players), communications links (which players talk to whom) and transmitted information (what the players communicate and how). Every organization has a different architecture depending on their mission. Architectures for most joint warfighting commands now exist and functional architectures for each battlefield function have been developed. An example of an organizational architecture is the CINC architecture for CENTCOM. A functional architecture example is the fire support architecture for the joint fire support system. [12]

Both operators and communicators must understand these definitions and accurately define where the C^3 systems must interoperate. They must define the standard operating procedures and the technical requirements necessary for the C^3 system to

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function. The _users_ of the C^3 system must identify those critical interfaces requiring C^3.[13]   An architecture gives us a solid framework to develop a comprehensive test and evaluation program. Without an architecture we will surely become lost and execute a weak and ineffective evaluation program.

WHY NONINTEROPERABILITY?

The lack of interoperability or noninteroperability has been a worry for the military for years. But despite our technological advantage, we will not achieve interoperability until the political desire for interoperability becomes institutionalized and as important to the services as service parochialism.

Most reasons for noninteroperability seem naive and insignificant at first glance, but point toward a parochial attitude dominating our services and DOD. Norman Augustine, the president of Martin-Marietta, proposes "three principal reasons (for noninteroperability): active intent, neglect and consent."[14]

The first reason, _active intent_, occurs when a developer purposely builds in incompatibility. Fortunately, we do not see this within DOD, but built-in incompatibility occurs often in the private sector. The second reason for noninteroperability, _neglect_, is a result of sheer negligence. Officials in all services have allowed the purchase or development of hardware incompatible with that from another service. In 1974, the Air Force assumed the lead in developing the Joint Tactical Data Information Distribution System or JTIDS. JTIDS was a better

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system to distribute computer data across the battlefield. Almost before the first contract, the Navy began development of its own tactical information distribution system. Despite assurances to the contrary, the Navy's effort did not interoperate and all attempts at interface became fruitless. The Navy finally ceased work after congressional pressure and joined the Air Force JTIDS effort. Fortunately, the DOD has minimized similar cases of neglect for the past 20 years.[5]

The most common reason for noninteroperability is consent or considered judgement. Considered judgement occurs when we know a development decision will result in noninteroperability and after considering the alternatives we vote to accept the noninteroperability. Conflicts in requirements cause most of these types of noninteroperability.. For example, an Air Force airplane doesn't have to operate from an aircraft carrier, and Army equipment has no requirement to meet the same saltwater standards as the Marine Corps. Therefore, each service builds their system to operate in their peculiar services' environment without concern for the possible need of the other service. Development schedules and fielding dates of hardware may also cause long or short term noninteroperability.

Often pure technical incompatibility causes noninteroperability. The current digital message devices for both Marine Corps and Army fire support systems are incompatible and noninteroperable. These are new systems built to operate with larger fire support systems still in development. These

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larger systems have noninteroperable interfaces which ensure noninteroperability for many years in this important battlefield functional area.[16]

Political forces lie at the root of noninteroperability. The political forces may originate in the private sector or in the services, but parochialism and the not-invented-here syndrome are all symptoms of the disease called politics. Politics loom even larger when one notices that interoperability problems have not been corrected by the leadership possessing the power to make the corrections.[17] We can now see a justification for test and evaluation of C^3 interoperability. If Congressional embarrassment and regulations cannot ensure interoperable C^3 systems, perhaps a mandatory certification system is the only solution.

<u>**WHERE ARE WE TODAY?**</u>

Why DOD has not responded to interoperability problems in a more vigorous manner is unfathomable. The absence of motivation cannot be due to a lack of impetus. Grenada was a fresh memory, and Congress conducted nonstop hearings on the subject. In 1985, the Senate Armed Services Committee questioned why the DOD had not revised its interoperability directive as promised nine years earlier. Growing impatient, the chairman warned the Secretary of Defense:

> "If necessary, the Senate Armed Services Committee is willing
> to consider a legislative restriction on the expenditure of any
> funds for communication equipment until meaningful progress is
> made toward resolving these bureaucratic problems."

Within a few months, on 9 October 1985, the DOD directive

was revised.[18] After the oversight by Congress and an abundance
of rationale to solve interoperability, what has been the
progress?

DOD has taken many actions to achieve C^3 interoperability.
A survey of the seventeen communicators in the Army War College
Class of 1991 was conducted to determine their experiences with
C^3 interoperability in their field assignments. Over half of
those responding felt there "had been a large increase in
emphasis" in C^3 interoperability during the past few years.[19]
Because of this emphasis and on-going DOD programs, almost all of
the respondents felt the "interoperability environment was going
to get better in the 1990's."[20]

Interoperability must begin in military units in order to
develop the doctrine, tactics, and techniques before applying
technology. A recent review of the Joint Uniform Lessons Learned
file (joint readiness exercise after action reports and
operational lessons learned) revealed operational deficiencies as
the major cause of noninteroperability rather than technical
problems. Examples of these operational weaknesses are: lack of
planning, poor joint procedures, poor knowledge of the existing
procedures, and insufficient joint training.[21]

An example of a problem in procedural interoperability
occurred in 1983. The General Accounting Office criticized the
DOD for allowing the Army and the Marine Corps to develop
different and noninteroperable fire support systems.[22] Today in
Desert Storm, Digital Entry Devices (a hand-held terminal for

burst radio communications over existing radios used for
requesting fire support) are not interoperable between the Army
and Marine Corps. The devices employ different communication
protocols and use different types of message formats. Each of
the two services' programs have been dissimilar for years and no
one expects the devices to interoperate in the near term.[23]

Technical C^3 interoperability must begin by identifying the
requirements early in the development process. Early
identification of the requirements will allow the design, test
and employment of the C^3 system to be an evolutionary process
with the appropriate design decisions made during its life cycle.
An example of noninteroperability from a technical aspect is the
Secondary Imagery Dissemination Systems (SIDS). The SIDS
transmits digital imagery from strategic sources to tactical
units. With the five SIDS and one secure facsimile system now in
use, only one system is interoperable with more than one other
system. In Desert Storm, the Central Command (CENTCOM) requires
three SID systems to satisfy its imagery needs instead of one.
The solution to the procedural interface problem is interoperable
protocols that allow the systems to share data, but the systems
will remain noninteroperable because the hosting communications
are not technically interoperable .[24]

Another example of technical noninteroperability is the
inability of the services and NATO to agree on an identify friend
or foe (IFF) aircraft identification system. More than 15 years
have passed since the U.S. and NATO began research and

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development to replace the Mark X/XII IFF system. Costs to implement the program ($92 billion) may delay the implementation, but fielding could begin by 1994. The biggest impediment to this system has been political. The cumbersome NATO decision process cannot keep pace with the advancement of technology.[25] The lack of an IFF system for Desert Storm has not hampered operations thanks to a jury-rigged system and no enemy aircraft. The lack of an interoperable IFF would have been serious if the enemy had flown against the coalition with any significant numbers of aircraft.

Technical interoperability joins operational and procedural interoperability when one considers computer systems. As digital communications systems become the norm and as computers begin to replace voice as a means of communication on the battlefield, DOD must move toward the interoperability of data and computer systems. One of our newest CINC'S, the Transportation Command (TRANSCOM) must orchestrate over 100 separate computer systems to interoperate.[26] The solutions are operational- get all parts to use the same systems at a great expense to all, or get all parts to follow the same formats and procedures and each part to ascribe to a basic technical standard for interoperability. These solutions are not practical but practical solutions do not work when a problem like that of computer interoperability becomes so unsurmountable.

DOD'S REMEDIES

Earlier in this paper we discussed the historical events that placed c^3 interoperability in the spotlight. Of these, Grenada was the pinnacle event. We saw how the Senate Armed Services Committee Chairman threatened to cut off all FY86 funding for c^3 systems unless significant progress was made. This threat gave momentum to DOD efforts for c^3 interoperability.

Written direction came first. DOD published and updated Directive 4630.5 in October 1985 and the JCS published the JCS Memorandum of Policy (MOP) 160 in January 1986. These two documents became the catalyst for progress in c^3 interoperability. What did DOD 4630.5 provide? U.S. policy was to field c^3 systems that met the needs of U.S. forces and was interoperable with other U.S. systems and those of our allies. It also stated:

> "The degree of necessary interoperability shall be determined during the requirements validation process and shall be ensured through the acquisition process, deployment and operational life of the system."[27]

This passage is significant because for the first time placing interoperability as a part of the acquisition process became a requirement. The services have continued this momentum and placed interoperability as a necessary requirement and a stated acquisition objective in their regulations.

JCS MOP 160 used DOD 4630.5 as a springboard to give an even more detailed and directive regulation. MOP 160 states c^3 interoperability is a basic need and the Joint Tactical c^3

architecture will be the basis for compatibility and interoperability. Among other facets of this regulation, MOP 160 stipulates the missions of the Joint Tactical Command and Control Agency or JTC^{3}A. DOD formed the JTC^{3}A in 1985, during the rush to solve C^3 interoperability.[28]

MOP 160 assigned JTC^{3}A several missions:

-Develop the Joint Tactical C^3 architecture
-Review all CINC, Service and DOD agency requirements for tactical C^{3}I systems to determine whether they must interoperate with the joint architecture.
-Develop tactical interoperability standards to support the Joint Tactical C^3 architecture.
-Establish a tactical C^{3}I interoperability testing and certification program.(More on this program later)
-Make certification recommendations to the Joint Chiefs of Staffs based on the results of this testing.
-Provide a Joint Tactical C^3 Test Center for use by all DOD components to ensure interoperability.
-Develop, in coordination with the Services, joint and combined compatibility and interoperability test and evaluation criteria to be used in the services' acquisition test programs.[29]

The above missions in the JCS policy and the importance assigned to interoperability by DODI 4630.5, firmly places JTC^{3}A as the primary focus for DOD efforts in C^3 interoperability improvement.

JTC^{3}A's SOLUTION

JTC^{3}A has gained a fine reputation for solving some of the more elusive problems in the C3 interoperability arena. Brigadier General Mallion, director of the Joint Tactical Command Control and Communications Agency (JTC^{3}A) sees the solution to interoperability as a four step process. You must:

-Identify requirements
-Develop standards
-Test and certify against the standards
-Implement and plan support.[30]

Following these steps provides insight of DOD's progress in
interoperability.

-Identify requirements:

The Joint Tactical C^3 architecture is the basis for
requirements. This JTC3A developed architecture is the roadmap
for the development of our test and evaluation system. As
previously discussed these architectures consist of CINC
architectures and also functional architectures.

-Develop standards:

JTC^{3}A has been the main thrust for C^3 interoperability
standards. The standards business has grown with the requirement
for interoperability. Standards have grown so much that we need
to consolidate standards management and control within DOD. The
migration of the areas of information, information processing and
telecommunications toward each other has exacerbated the control
of standards. Today too many agencies exist with varying degrees
of control over the standards process. Technical standards
involve twenty-eight organizational entities, and procedural
standards involve another forty organizations. Operational
standards are conceptual, and responsibility has not been affixed
for their development. Proposals exist to establish a DOD Center
of Standards under the JTC^{3}A. Consolidation of standards
development and control under one organization is the purpose of
the Center, but the transition from the current field of over one
hundred involved organizations to a single agency will be a
battle in itself.[31]

-Test and certify:

Currently no universal policy exists for the application of standards to testing for c^3 interoperability. To demonstrate interoperability today, each of the thirty plus development and procurement organizations are free to use their set of standards during testing. If each of these agencies tested diligently and in an unbiased manner, the test results still would not ensure interoperability. Interpretation of procedures, implementation of test plans and several biasing factors could affect the test product. We need a central organization to design the tests and develop a set of standard test procedures for c^3 interoperability.[32]

-Implement and plan support:

This final step was an enormous undertaking during Desert Shield. The U.S. Army units deployed to Desert Shield with three different communications architectures. We were in the process of fielding the Mobile Subscriber Equipment (MSE) and the SINCGARS (single channel ground airborne digital FM radio subsystem). Additionally, we had several units equipped with the old VRC-12 suite of equipment. Continuously during the deployment and in theater, fielding of new equipment occurred. But, the cycle cannot end with fielding. Support must continue after fielding and throughout the life cycle of the equipment. Joint exercises and deployments must be monitored closely, and lessons learned captured and distributed to the joint force.[33]

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STATUS TODAY?

As just mentioned, giant strides have been made in the past five years, but we are still far from having an interoperable c^3 system. Mr. Dick Howe, the Director of Theater and Tactical c^3 at the DOD c^3I, feels we have progressed but are moving too slowly and are far from completion. In the area of protocols, architectures and interfaces we are making progress. In data interoperability (computer to computer), the picture is dismal; terrible within the services and unmentionable between the services. In air defense we do not have a joint system and our fire support systems do not interoperate. Many solutions to interoperability weaknesses are possible but only one method will work with certainty. We must start managing c^3 interoperability through the budget. If we withhold procurement dollars because a system does not interoperate, we will need to do it just once. The service and agency parochialism is so strong, funding is the only way to force progress.[34]

JCS action officers feel progress continues but progress is slowing since the services first completed the easier tasks. Strength in regulations governing c^3 interoperability exists, but very little enforcement of these regulations occurs. Again, control the funds and the c^3 interoperability will follow.[35]

For a service perspective, Department of the Army staff members gave their views of the current status of interoperability. These staff officers feel the development of

C^3 interoperability is not being accomplished correctly. The
operational interoperability must be solved first, then the
procedural and finally the technical interoperability. The
SINCGARS program provides an example of what reversing this order
does to interoperability. SINCGARS radios' encryption occurs at
every level in the U.S. Army, but in the German Army no
encryption below the brigade level occurs. To interoperate with
the Germans, we must develop expensive interface devices to place
our radios back in the non-encrypted mode. The operational and
procedural problems needed solving before the United States and
Germans fielded their new tactical radios. We must always look
forward with our architectures and standards. If we wait for the
technology to mature near the completion of development and then
develop a standard or redesign an architecture, we will continue
to build workarounds and patches to fix the interoperability
failures. To ensure compatibility and interoperability we must
test, but test during development, not after.[36]

WHY TEST?

Testing is one of the most commonly known phases of the
acquisition process but the least understood. Unfortunately,
this misunderstanding is held by many of the people involved in
acquisition itself. Because the word "test" has a negative
connotation and testing is expensive, those who misunderstand
testing often avoid it. Testing has three major purposes: first,
testing provides information to the developers to aid them in the

next phase of development. Second, testing allows the tested item to be placed in an environment or in conditions not normally available to the developer like live fire tests, air drop testing and the opportunity to interoperate with other systems. Third, testing gives all decision makers information about a developmental system's potential. In this role testing should have a degree of impartiality to present an unbiased view of the tested system.

Testing is divided into two general categories - developmental test and evaluation (DT&E) and operational test and evaluations (OT&E). As defined in DOD Directive 5000.3, developmental testing is done throughout the development cycle to ensure the system meets technical specifications and to give information to the engineering designer for continuous improvement during development.[37] This feedback is critical for hi-tech items that change during development due to new or improved technologies. The Patriot missile is an example of a system designed as an anti-aircraft missile system but improvements in micro-electronics and software allowed the Patriot to evolve into an anti-missile missile weapon. Operational testing or OT&E is a field test, under realistic combat conditions, where representative soldiers and units operate the developmental item. The objective is to determine the system's operational suitability and effectiveness.[38]

C^3 INTEROPERABILITY TESTING

The JCS MOP 160 is the impetus for a strong test and

evaluation program within C^3 interoperability. This regulation

directs us to derive our new requirements from the joint tactical

architecture and also directs:

> "Interoperability standards and operational procedures
> applicable to these requirements will be identified and will be
> part of the basis for system development. Systems and their
> interfaces will be tested to verify proper implementation of
> necessary interoperability standards and will be certified for use
> in joint and combined operations. Joint and combined tactical C^3I
> training, doctrine, concepts, and operational procedures will be
> evaluated using the Joint Exercise Program".[39]

The regulation continues to mandate that the service components

do testing with JTC^3A coordination both during the acquisition

process and after the acquisition process as required. JTC^3A

should witness these tests, review reports and based on these

observations certify the systems to the JCS as suitable for use

in joint operations. Other testing outside the acquisition cycle

may be required. This out-of-the-acquisition cycle category of

testing represents the bulk of C^3 interoperability testing the

past few years. The lack of c^3 interoperability certification

for C^3 systems already in the field or systems completing the

normal acquisition cycle testing (DT&E and OT&E) without

certification caused this abundance of out-of-cycle testing.

Also, the Congressional and DOD interest in "jointness" since

Goldwater-Nichols in 1986, caused C^3 interoperability evaluations

during joint exercises to reveal more faults in the C^3 systems

which required more testing.

MOP 160 is very direct when it states: "JTC^3A will

coordinate with testing agencies to ensure achievement of

required joint and combined interoperability while <u>avoiding</u> <u>duplication of testing.</u>"[40]

JTC3A must ensure that the result of expanding their test program is not duplication of testing. The services feel this danger already exists. No service wants to go to JTC[3]A's test facility, the Joint Interoperability Test Center (JITC), and have their system fail. Instead they do pretesting or "Initial" OT&E before they go to JITC.[41,42] Review of the U.S. Army's five year test plan and JITC's Five Year Interoperability Assurance Plan verifies this pattern for some systems, and more systems will likely follow this pattern of duplication.[43,44]

The JTC[3]A conducts three types of testing and also participates in joint exercise evaluations. JITC conducts technical interoperability testing using one of the most comprehensive suites of communications equipment within DOD, including Tri-service Tactical Communications (TRI-TAC), Mobile Subscriber Equipment (MSE) and various service-unique transmission systems and terminal devices (see Appendix C-1 for details of the JITC communications). The JITC simulates communication traffic to stress the equipment during testing, and this equipment precludes the need for tactical units involved in the test.[45]

Technical testing at the JITC consists of the certification of interfaces between two or more pieces of communications equipment, between two or more systems or all the interfaces within a system. The testing may also examine the interface

between the C^3 system and the intelligence system. A graphical portrayal of all these interfaces is at Appendix C-2. DOD will normally assign JITC as the responsible test organization for joint or combined technical interoperability tests.

Conformance testing (a form of technical testing) assists civilian industry in meeting government standards. By certifying against DOD interoperability standards, a civilian firm can have a distinct marketing advantage and his products should be less costly to the government. The civilian contractors pay for this testing.[46]

JTC^{3}A conducts procedural testing through a distributed architecture which connects test participants throughout the United States. For example, air defense command and control test facilities are at each of the services' test sites and connect to JITC by leased commercial lines. Using these distributed sites, an air defense test simulator evaluates the interoperability of tactical automated digital information links (TADIL).

In the near future, a system called the Joint Interoperability Evaluation System (JIES) will perform the procedural tests. JIES will have the capability of testing the new tactical automated data link (TADIL-J) or any other digital message format for joint or combined use. Both TADIL and message text format testing can use the JIES's distributed networks and portable testers at remote locations to "stress" the systems by simulating the high traffic volumes. Also provided in the field are recording and analysis capabilities. (See Appendix C-3 for a

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graphical representation of the JIES.)[47]

Operational interoperability testing has not evolved at JITC or within DOD. The Joint Exercise System has been the only means of evaluating the operational aspects of interoperability. On these exercises, JITC conducts evaluations of message text formats, but overall, operational interoperability has not faced the rigor of test and evaluation. During interviews within DOD, JCS, JTC^{3}A, and the services, the opinions were evenly divided whether or not the JITC should conduct tests of joint C^3 interoperability issues during joint exercises. The Grenada experience indicates we should evaluate interoperability on joint exercises, and many of these evaluations should be no-notice exercises. If we evaluate and train using the past methodology of joint exercises, we allow the communicators to use a six month planning period to develop solutions for the problems ensuring the true C^3 interoperability issues never surface during the exercise.[48] Additionally, with planned resource reductions, joint exercises will occur less frequently. Therefore, we must increase the value of joint exercises and squeeze as much information out of them as possible.

Fears of testing contaminating training must be eliminated. Techniques for testing and training to co-exist are available. Compromises must be made by both the tester and the trainer ,but the end result must be tolerable for all participants. The key to this mutual benefit lies in having the tester involved early in the planning and to have the testers totally involved in the

execution. Testers must be prepared to accept less fidelity while capitalizing on statistical techniques to maximize the information/data collected. Likewise, during the joint exercise, trainers must accept some intrusion and post exercise data collection, but all the training objectives can be met.[49]

For C^3 interoperability evaluation to improve, the services must examine the requirement for C^3 interoperability when they initiate the requirement for new hardware or for an entire system. As a part of this documentation process, the requirements document and the test and evaluation master plan (TEMP) are sent to the other services, DOD and JCS for staffing. In the case of the TEMP, staffing begins when the TEMP is sent by the service to the Office of the Director for Test and Evaluation, Director of Research and Engineering, Under Secretary of Defense for Acquisition. This office then distributes the TEMP to all the organizations listed above, and the staffing is done simultaneously by each organization. JTC^{3}A reviews the TEMPS for C^3 interoperability issues in great detail. Other organizations with less manpower but with equal responsibility for C^3 interoperability, review the same issues. This duplication is unnecessary and should stop. The JTC^{3}A should review the TEMPS (and also requirements documents) first, and prepare detailed comments for review by the other agencies while they review the basic document. This extra step would capitalize on the strength and expertise of JTC^{3}A. For example, the Assistant Secretary of Defense for Operational Test and

Evaluation, has one officer who conducts the review of all the aforementioned documents in the same detail as the entire staff of JTC³A. He is not able to view the documents either from an executive level or from a detailed level due to the sheer volume.[50] In order to capitalize on the JTC³A, the JTC³A staff must review and comment on the initial documentation before initiating the acquisition process.[51]

Once the TEMP is approved and the acquisition process begins carrying the new system through development, the JCS MOP 160 requires the services to provide their C^3 interoperability test requirements to a process called the Five Year Interoperability Assurance Plan (FYIAP). The FYIAP's purpose is to identify, document, and track requirements for interoperability certification of joint and combined tactical C^3I equipment and system interfaces. This process occurs annually and requires ten months for test approval. Most organizations surveyed thought this process was too slow and cumbersome. [52-55] Besides, the FYIAP process does not document all interoperability testing. The FYIAP mostly tracks the test and evaluations conducted at the Joint Interoperability Test Center or just those involving JTC³A. DOD does not capture the C^3 interoperability testing done by the services at their own test facilities nor is this information consolidated in a central document or data base. [56] This condition, while not catastrophic, is contrary to DOD and JCS policy and does not afford the opportunity to avoid duplication of resources and duplication of testing. JTC³A should develop

procedures to capture and document the entire c^3 interoperability testing effort.

The final topic warranting discussion is test and evaluation terminology. At Appendix D is a chart of the terminology used by the DOD, (JTC^3A), the Army and the Air Force. A review of this terminology indicates only the broad categories of development test and evaluation (DT&E), operational test and evaluation (OT&E) and production tests are similar. Each DOD service conducts other types of testing and classifies these tests with titles bearing special meanings to the services. To someone trying to coordinate or review a joint test and evaluation program, the different terminologies are confusing and only add to the growing list of acronyms. At least the JTC^3A should attempt to standardize the test and evaluation terminology for c^3 interoperability test and evaluation.

THE FUTURE

c^3 interoperability has progressed immensely in the past five years, but what is the future direction of c^3 interoperability? As new technologies such as robotics and space systems are developed, where do we draw the bounds of c^3 interoperability? The most demanding and difficult of these future challenges is standards. We are still catching up on standards development and the resultant testing against those standards. DOD must develop standards for future systems. When technology is young, standards should begin their development and then mature with the technology. For example, the standards

development is closely following the new architectures for satellites. These new standards are an example of establishing standards as the technology matures. However, there are few standards for the c^3 areas in robotics.[57] We must solve our future (predictable) standards problems now, and not after each service has developed their own unique solution.[58]

As mentioned in preceding paragraphs, a prerequisite to getting standards development in order is to solve the disorganization in the standards arena. Presently the responsibility for standards development is split between the DOD Comptroller, OSD Production and Logistics and the ASD/C^3I. How can standards move into the future with no one in charge? JTC^{3}A has a plan to develop a Center of Standards, but the services and DOD agencies must drop their protectionist tendencies and support this initiative. Stand alone systems must become a thing of the past.[59]

One of the most promising future involvements of c^3 interoperability is also an area in great need of standards architectures and joint discipline. This new area is simulations and war gaming. If all of the services and JCS had compatible and interoperable war games, the synergism would be astounding. Besides training, we could include real world communications, data links, and operational procedures. The training concurrent with testing and evaluation would be similar to the benefits discussed earlier for joint exercises. Additionally, as repetitions of the war games increased and a data base of the

performances was built, measurement of the effectiveness of new systems versus old systems could be available. This evaluation would allow us to determine if the value added by the new systems warrants development or production.[60]

Training simulations has been touted for years for many diverse applications. Linking these simulations, while a formidable task, promises an immense payoff. The Defense Advance Research Projects Agency (DARPA) has supported some of the first trials in this area with promising results. Interestingly, the technical problems were not as large as the bureaucratic obstacles. The policy, programming and budgetary obstacles encountered highlighted a major deficiency: no DOD organization is charged with managing, promoting and directing a simulation effort of this magnitude. We need to build a DOD/JCS exercise support system capable of standing alone but also able to link with other simulations depending on the training, testing, evaluating or education objective. With simulation standards an automated exercise support system is possible, but without standards this system is just a dream. If fielded, a joint simulation system would allow JCS/CINC exercises, combined war college programs, C^3I operational test and evaluation, technology assessments and even mission/plan rehearsals.[61] New levels of realism in simulation are available through quantum improvements in computer technology that will allow even better training in the future. We must get this program under control for a greater joint payoff in the future.

CONCLUSION

The most significant defense reorganization in forty years promoted wholesale changes within the Departments, within DOD and mainly within the Joints Chiefs of Staff. With these changes came legislation promoting jointness and maybe with jointness will come command and control interoperability. Perhaps these changes will also diminish the parochialism inhibiting our c^3 development in the past. We must remove these bureaucratic barriers because some of the biggest challenges in c^3 interoperability are still to come. Examples of these future challenges are data links and computer-to-computer communications. These two areas contain c^3 interoperability problems of almost unfathomable complexity.[62]

This paper has discussed several areas of potential payoff for c^3 interoperability improvement through test and evaluation. The main theme has been to get control of the standards process. Without timely standards, hardware and software cannot address interoperability during their development. When standards are late being developed, test and evaluation programs must catch up with the technology by testing duplication or by costly out-of-the-acquisition cycle testing. With timely standards and well developed test and evaluation programs, we can conduct the majority of our tests and evaluations during the acquisition process, thereby saving money and time.

The test and evaluation programs of the services are necessary and should be the primary means of c^3 interoperability

testing. JTC³A can validate these programs by distributed communications through the Joint Integrated Evaluation System. JTC³A should also be the evaluator of all joint systems and equipment. To perform these functions they must develop a set of procedures to allow the services to conduct testing at their facilities and concurrently conduct joint interoperability certification in a distributed manner through the JITC.[63]

DOD and JTC³A should streamline their staffing to capitalize on the capabilities of their special agencies. JTC³A has a staff of over three hundred c³ interoperability experts whose skills must be made available to the DOD/JCS staff as in a matrix support organization. JTC³A has done a great job in supporting the CINC's, but now they must turn some of their attention to the services' staffs and to the DOD/JCS staffs.[64]

DOD should take the lead in standardizing testing terminology. Some officials in the JTC³A see no issue in the various testing terms,[65] but others within DOD and the services see a problem in the interpretation of the various test results.[66] Within DOD and c³ circles we may understand our terminology, but as we increase our joint staff interaction we should use compatible terminology. A simple solution is to use the common term, and if the common term doesn't convey the proper meaning then have another term approved at the joint level before using it.

c³ interoperability must be evaluated more on joint exercises than in the past. We must also include no notice

exercises frequently to test our ability to interoperate rather than our ability to solve noninteroperability problems when given enough time.

To expand the definition of joint exercises, DOD must gain control of the fast approaching area of war games and simulations. DOD should force these simulations to interoperate in a joint simulated war game using organizational C^4I systems and exercising scenarios over actual terrain. The potential in this field is so enormous that to not harness the joint potential is imprudent.

Finally, the DOD and the services must be willing to shelve parochialism and petty bureaucracy to formulate a true joint command and control capability. Without a hard-nosed approach by our senior leadership and renewed cooperation at the mid-level of our organizations, we will continue to patch, rework and seek solutions to yesterday's dumb decisions.

APPENDIX A

GLOSSARY

Advanced Field Artillery Tactical Data System - AFATDS is a U. S. Army ADP system which supports planning, coordination, control, and execution of close support counterfire, interdiction, and suppression of enemy fire. AFATDS will replace the Tactical Fire Control System (TACFIRE).

AN/TSQ-73 - The AN/TSQ-73 is a U.S. mobile, tactical, automated air defense information distribution system for ADA brigade and battalion commanders. Assignment of targets to units is automated, as well as notification that friendly aircraft are not to be fired upon.

Army Tactical Data Link-1 (TADL-1) - A point-to-point, real-time digital data link using serial transmission frame characteristics and standard message formats at a basic speed of 1200yyyy bps. This data link interconnects Army tactical air control/defense-oriented systems. The Marine Corps also uses this link type for control and coordination of SAM systems by the TAOC.

All Source Analysis System - ASAS is a U.S. tactically deployable system to accept, process, integrate and report information from multiple sources in the electronic warfare area. It is a system for command and control in the IEW functional area.

C^3I System - Command and control systems as defined in JCS Pub 1 and within the context of subparagraph 2b (Scope) as it pertains to intelligence systems. That is, the facilities, equipment, communications, procedures, and personnel essential to a commander for planning, directing, and controlling operations of assigned forces pursuant to the missions assigned. In regard to intelligence systems, applies only to the interfaces between tactical C^3 systems and either tactical or nontactical intelligence systems and to the interfaces between those communications systems that support intelligence systems. Also includes the term "C^3 systems." The term "equipment" is meant to include both hardware and software aspects of such equipment. (JCS MOP 160)

Channel - A single independent path for transmitting electrical signals over a pair of metallic conductors, a radio link, or as derived from multiplexing a wideband circuit.

Circuit - An electrical path between two or more points capable of providing two-way communications.

Combined - Between two or more forces or agencies of two or more allies.

Command - 1. The authority that a commander in the military service lawfully exercises over subordinates by virtue of rank or assignment. Command includes the authority and responsibility for effectively using available resources and for planning the employment of, organizing, directing, coordinating, and controlling military forces for the accomplishment of assigned missions. It also includes responsibility for health, welfare, morale, and discipline of assigned personnel. 2. An order given by a commander; that is, the will of the commander expressed for the purpose of bringing about a particular action. 3. A unit or units, an organization, or an area under the command of one individual. 4. To dominate by a field of weapon fire or by observation from a superior position.

Command and Control (C^2) - The exercise of authority and direction by a properly designated commander over assigned forces in the accomplishment of his mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission.

Command and Control Element (C^2E) - An element of a command control network. C^2Es provide commanders with the facilities required to plan, direct, coordinate, and control the operations of their forces. Each C^2E includes the essential equipment, communications, personnel, and procedures to perform its functions. C^2Es may be subdivided into operational facilities (OPFACs) and action elements(AEs),q.v.

Command and Control (C^2) System - The facilities, equipment, communications, procedures, and personnel essential to a commander for planning, directing, and controlling operations of assigned forces pursuant to the missions assigned.

Commonality - A quality which applies to material or systems: 1. Possessing like and interchangeable characteristics enabling each to be utilized, or operated and maintained by personnel trained on the other without additional specialized training. 2. Having interchangeable repair parts and/or components.

Communications - The process, method, or means of conveying information from one person/point to another.

Communications Network - An organization of stations capable of intercommunications but not necessarily on the same channel.

Communications Protocol - A set of formal rules required to establish, maintain, and discontinue communications from the source to destination points.

Communications Security (COMSEC) - The protection resulting from

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all measures designed to deny unauthorized persons information of value which could be derived from communications; COMSEC includes cryptographic, transmission, and emission security, and the physical security of COMSEC materials and information; primarily guards transmissions against intercept and exploitation of traffic.

Communications Terminal - Terminus of a communications circuit at which data can be either entered or received; usually located with the originator or ultimate addressee.

Compatability - The ability of system components to co-exist with one another and with the environment in harmony,i.e., without mutual interference.

Data Terminal - Equipment employed at the end of a transmission circuit for the transmission and reception of data. It may include end instruments, signal converters, or both.

Digital Data - Information represented by a code consisting of a sequence of discrete elements.

Digital Signal - A discontinuous electrical signal that changes in frequency, amplitude, or polarity from one state to another in discrete steps.

FAADC^{2}I - The Forward Area Air Defense Command and Control Information Systems automates C^2 for air defense artillery(ADA) divisional and non-divisional units. This includes the exchange of ADA command information, the dissemination and acknowledgment of battle management data, and target dating (alerting and cuing) from remote sensor sources.

Format - A predetermined arrangement of bits or characters within a group such as a word, message, or language; the shape, size, and general makeup of a document.

Frequency Allocation - Assignment of available frequencies in the radio spectrum to specific stations/users for specific purposes to maximize their utilization with minimum interference.

Frequency Hopping - An electronic counter-countermeasure(ECCM) technique in which the instantaneous carrier frequency of a signal is periodically relocated, according to a predetermined code, to other positions within a frequency spectrum much wider than required for normal message transmission. The receiver uses the same code to keep itself in synchronism with the hopping pattern.

Frequency Modulation(FM) - In modulation, where the frequency of the carrier waves varies in accordance with the signal to be sent, and the amplitude and phase of the carrier remain constant.

Frequency Spectrum - The range of electromagnetic wavelengths from

the lowest radio frequency to the highest light frequency; the usable communications spectrum extends from 30 Hz(ELF) to 100 Tera Hz for lasers.

High Frequency (HF) - Comprises the frequency band of 3 to 30 MHz with a wavelength from 10 to 100 meters.

Imagery - Collectively, the representations of objects reproduced electronically or by optical means on film, electronic display devices, or other media.

Interface - The interconnection between two equipments or systems/networks, specifications for which include the type and function of interconnecting circuits and the type and form of signals to be interchanged.

Interface - A boundary or point common to two or more similar or dissimilar command and control systems, subsystems, or other entities against which or at which necessary information flow takes place.

Interoperability - 1. The ability of systems units or forces to provide services to and accept services from other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together. 2. The condition achieved among communications-electronics systems or items of communications-electronics equipment when information or services can be exchanged directly and satisfactorily between them and/or their users. The degree of interoperability should be defined when referring to specific cases.

Interoperability Standards - Technical and procedural interface standards, including those developed under the Defense Standardization and Specification Program, required to ensure the ability to exchange information between C^3I systems and equipment.

JINTACCS - The Joint Interoperability Tactical Command and Control System program establishes standard interfaces for information exchange among automated and manual tactical facilities planned for the 1980s timeframe; purpose is to insure compatibility, interoperability, and operational effectiveness among U.S. air and ground tactical C^2 systems.

Joint Tactical Command, Control, and Communications Architecture - The aggregate of documented elements of a JTC^3 program that define and guide the planning, programming, development, testing, evaluation, implementation, and configuration management of entities that compose the program. The JTC^3 architecture accomplishes the following: a. Describe the overall concept for tactical command, control, and communications and nonstrategic nuclear forces C^3 in joint and combined operations based upon the threat projections and force requirements approved by the Joint

Chiefs of Staff. b. Identifies the characteristics of tactical C^3 systems supporting joint and combined operations necessary to meet the following validated requirements: (1) Operational and system performance requirements. (2) Interconnectivity requirements. (3) Secure communications requirements. c. Documents the technical and procedural interface standards required to achieve systems compatibility and interoperability. d. Documents the procurement and fielding schedules needed to meet implementation objectives.

JTIDS - The Joint Tactical Information Distribution System is an advanced, jam-resistant, secure digital voice/data communications system that will provide LOS and extended LOS C^3, navigation, and identification capabilities to service tactical air and ground force elements.

Low frequency (LF) band 30 to 300 KHz.

Link - In communications, a general term used to indicate the existence of communications facilities between two points.

Message Standards - Message standards are message formats, formatting rules and conventions, and acknowledgement instructions, supported by data standards.

Mobile Subscriber Equipment (MSE) - An Army sponsored program to provide a secure, survivable, mobile radio-telephone network for tactical forces (corps and below) in the 1990s.

Net, Radio - A group of radio stations capable of single channel intercommunication (one-way or one-way reversible) on the same assigned frequency with one station serving as net control.

Network - An organization of stations capable of intercommunication but not necessarily on the same circuit; a functional component of a communications system composed of two or more circuits which form a general or special purpose net/network to support a specific mission.

Operational Procedures - The detailed methods by which headquarters and units carry out their operational tasks.

PATRIOT C^2 - Is a battalion mobile tactical ADA fire distribution system for control of up to six PATRIOT missile batteries. The PATRIOT Engagement Control System (ECS) at the battery provides fire control. Together they are the PATRIOT C^2.

Procedural Interface Standards - Consist of specifications for the manner of accomplishing the exchange of information across an interface. They define: a. The form or format in which information is to be exchanged. b. The prescribed information exchange language, syntax, and vocabulary to be used in the information exchange. c. Interface operating procedures that

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govern the information exchange.

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Protocol - Hardware and software procedures used to transfer cryptographic, voice, data, and control information between subscriber terminals and switching facilities; line protocol procedures may include synchronization, signaling, supervision, message transmission, and error detection and correction functions.

Radio Frequency (RF) - A frequency higher in the spectrum than audible frequencies, or above 25 KHz.

Redundancy - A term used by communicators to denote; (1) survivability of facilities through duplication to provide continuity of operations, (2) reliability of service through redundancy of equipment to offset system downtime, or (3) transmission capacity through redundant channels to accommodate unpredictable peak traffic loads.

Reliability - Demonstrated, satisfactory, and effective performance in accordance with program objectives in a realistic operational environment, for stated periods of time, without failure or performance degradation below specified

Standard - An exact value, a physical entity, or an abstract concept, established and defined by authority, custom, or common consent to serve as a reference, model, or rule in measuring quantities or qualities, establishing practices or procedures, or evaluating results. A fixed quantity or quality.

Standardization - Within NATO, the process of developing concepts, doctrines, procedures and designs to achieve and maintain the most effective levels of compatibility, interoperability, interchangeability and commonality in the fields of operation, administration and material.

Standing Operating Procedure - A set of instructions covering those features of operations which lend themselves to a definite or standardized procedure without loss of effectiveness. The procedure is applicable unless ordered otherwise. Also called standard operating procedure..

Tactical Command and Control (C^2) System - The equipment, communications, procedures, and personnel essential to a commander for planning directing, coordinating, and controlling tactical operations of assigned forces pursuant to the missions assigned.

Tactical Communications - Those communications system assets which are organic to and operated by tactical combat and combat support forces/units, usually in the form of mobile/transportable assemblages and components ruggedized for field deployment and redeployment; may embrace a wide variety of capability options to

include single and multichannel transmission, voice and message switching, COMSEC, and terminals.

Tactical Data System (TDS) - An interacting assembly of procedures, system processes, and methods which includes equipment specifically designed to collect, display, evaluate, and disseminate data for the purpose of supporting the command and control of military forces

Tactical Digital Information Link (TADIL) - A JCS approved standardized communications link suitable for transmission of digital information. A TADIL is characterized by its standardized message formats and transmission characteristics.

Technical Control - A term designating the functions of coordination, operational control, supervision, status reporting, testing, and restoration of transmission media, equipment, and circuits of communications facilities.

Technical Interface Standards - Consist of specifications of the functional, electrical, and physical characteristics necessary to allow the exchange of information across an interface between different tactical C3I systems of equipment

Ultra High Frequency (UHF) - The radio frequency band of 300-3000 MHz; used principally for line-of-sight radio/television, multichannel radio relay, and single channel satellite systems.

Very High Frequency (VHF) - The radio frequency band of 30-300MHz, used mainly for line-of-sight radio/television and multichannel radio relay systems.

MSP   QUESTIONNAIRE

FELLOW STUDENTS:

     I AM AT THE STAGE OF MY MSP WHERE I NOW NEED SOME EXPERT HELP. I USED THE BIO-BOOK TO SELECT YOUR NAME BASED ON YOUR COMMUNICATIONS-ELECTRONICS BACKGROUND. IF YOU COULD TAKE A FEW MINUTES TO ANSWER THIS SHORT QUESTIONNAIRE I WILL BE THANKFUL. IF YOU HAVE MORE DETAILS THAT YOU WOULD LIKE TO PROVIDE PLEASE CONTACT ME: LTC DON LOFTIS, SEMINAR 15, BOX 189, PH:245-9431

     MY MSP IS HOPING TO ANSWER THE FOLLOWING BROAD QUESTION:

TO WHAT EXTENT SHOULD TEST AND EVALUATION BE USED TO ENSURE THE DEPARTMENT OF DEFENSE C3 INTEROPERABILITY PROGRAMS ARE ADHERED TO AND OPTIMIZED?

     TO GET AT THE ANSWER, I HAVE VISITED/INTERVIEWED A MYRIAD OF AGENCIES AND STAFFS-DOD(C3/T&E/OT&E), JCS(J6/J7), JTC3A (FT HUACHUCA/RESTON), DA(C3/USAEPG/TECOM/OTEA), DAF(USAF FLT CENT), DN&MC(USN AVN TEST CENT), BUT I HAVE NOT RECEIVED ANY FEEDBACK FROM THE REAL WORLD. THIS IS WHERE YOU COME IN.

FIRST, I NEED TO KNOW YOUR EXPERIENCE BASE:
HOW MANY YEARS OF MILITARY C3 EXPERIENCE DO YOU HAVE? <u>19/20/20/3/3/20/22/20 years</u>
HOW MANY MONTHS OR YEARS DO YOU HAVE IN A JOINT C3 ENVIRONMENT?
<u>0/3.5/3/3/3/3/4/6 years</u>

SINCE THE **BAD PRESS** DAYS OF GRENADA, HOW WOULD YOU CHARACTERIZE THE EMPHASIS ON C3 INTEROPERABILITY?
        <u>1</u>   NO REAL CHANGE IN EMPHASIS
        <u>3</u>   ONLY A MINOR INCREASE IN EMPHASIS
        <u>4</u>   A LARGE INCREASE IN EMPHASIS
        <u>1</u>   A MAJOR PROGRAM WITH THE HIGHEST LEVEL OF EMPHASIS

WHAT AREA OF C3 DID YOU SEE THE EMPHASIS BEING APPLIED? (PROCEDURES, ARCHITECTURES, JOINT EXERCISES,T&E, ETC)

_____

_____

IN YOUR OPINION, IS THE C3 INTEROPERABILITY ENVIRONMENT GOING TO GET BETTER OR WORSE IN THE 90'S? <u>8</u>   BETTER <u>1</u>   WORSE

DOES DOD(TO INCLUDE THE SERVICES) HAVE AN ADEQUATE T&E PROGRAM TO ENSURE C3 INTEROPERABILITY? <u>2</u> YES <u>1</u> NO <u>5</u> DON'T KNOW
COMMENTS: _____

_____

Appendix B. Questionnaire

Commo Capabilities of JITC

SWITCHING

TACTICAL (TTC-39/39A,TYC-39, TTC-42
SB-3614, SB-3865)

STRATEGIC (DDNIC-30 SWITCH,
C70 NETWORK CONTROL))

RADIO

LOS (TRC-138A,TRC-173/174/175)

TROPO (TRC-170(V3))

HF (ITT MACKAY MSR-8000, TSC-122)

COMBAT NET RADIO (SINGARS,VRC-12)

SUOOORT (TROPO SATTELITESUPPORT
RADIO(TSSR))

SATCOM

TACTICAL (TSC-94A,WSC-3)

COMMERCIAL (VSAT)

TERMINAL

MULTIPLEX (TSQ-146,TCC-73)

VOICE (ANDVT,DNVT)

TELETYPE (MODEL 40,UGC-74)

COMSEC

TRUNK ENCRYPTION (KG-81,KG84)

VINSON (KY57/58)

DCVT (KY-58)

HF-PARKHILL (KY-65/75)

SDNTIU (KY-90)

STU-II/III (KY-71/77)

BLACKER FRONT END (BFE)

KG-40, KW-7,KG-13,KG-80

SIMULATION/ANALYSIS

TRAFFIC LOADING (TTM-8,

MESSAGE LOADING DEVICE

JOINT PORTABLE TADIL TESTER

MICRO MESSAGE ANALYSIS
SYSTEM (MICRO-MAS)

CONTROL

CNCE (TSQ-111)

TEST COORDINATION CENTER

DATA COLLECTION/ANALYSIS

VAX 8320

CONCURRENT 3200

MICRO-VAX

APPENDIX C-1

JITC's AUTOMATED TECHNICAL CONTROL -DISTRIBUTED C3I NETWORK

TRAFFIC LOADING

C3I SIMULATION

CONTRACTOR
FACILITIES

SERVICE
TESTBEDS

DCA
TESTBEDS

COMBINED
TESTBEDS

CINC'S

AUTOMATED
TECH
CONTROL

NETWORK MANAGEMENT

DATA COLLECTION
ANALYSIS
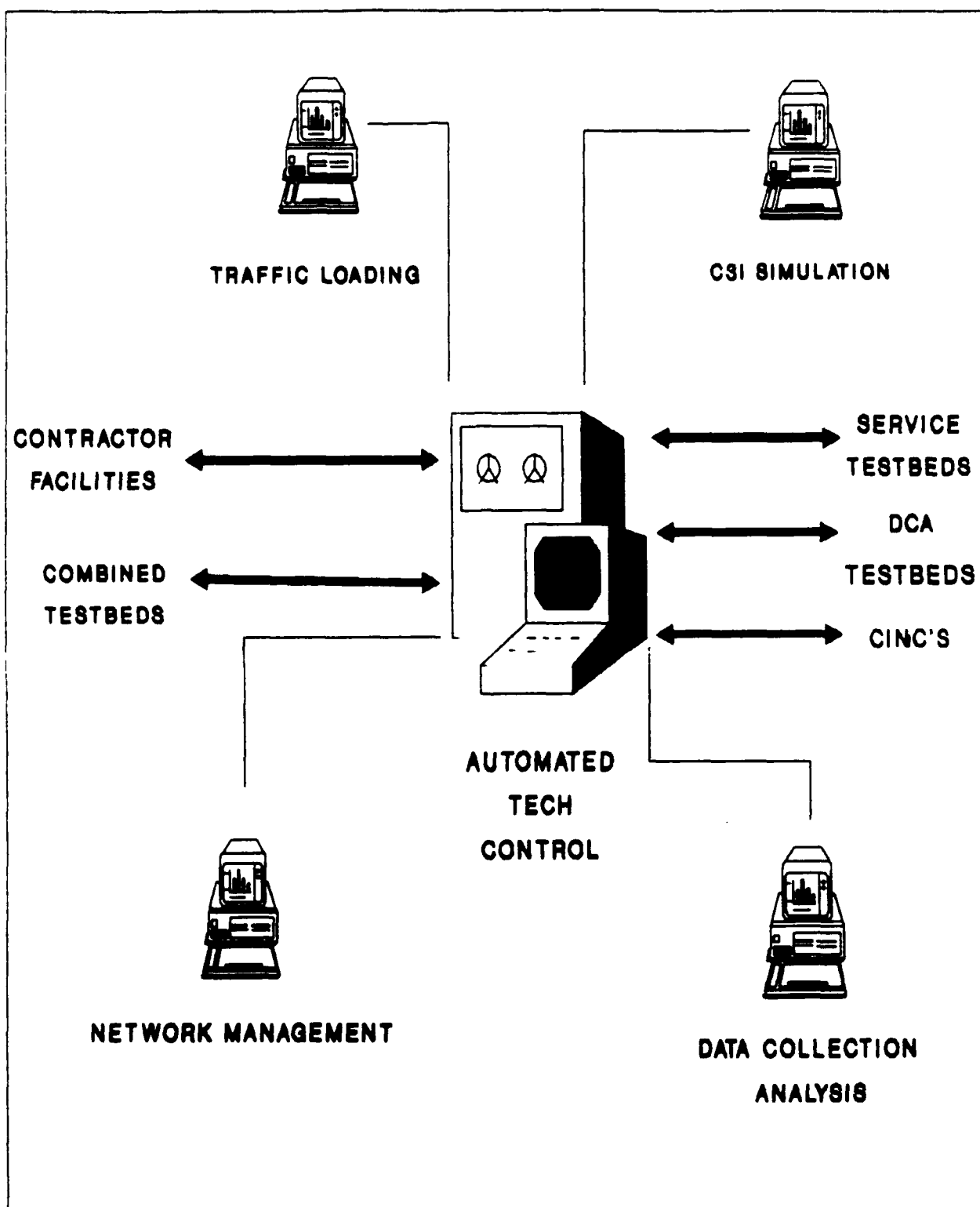
APPENDIX C-2

JIES DISTRIBUTED ARCHITECTURE

F-14D — **NAVY** — **JIES DISTRIBUTED NETWORK**

ACDS

E2C

NTDS

TAOM — **MARINES**

ATACC

JITC

MCE

AIR FORCE

E-3

F-16

ARMY

TSQ-73

PATRIOT

FAADC2

NSA

SIS   SIS
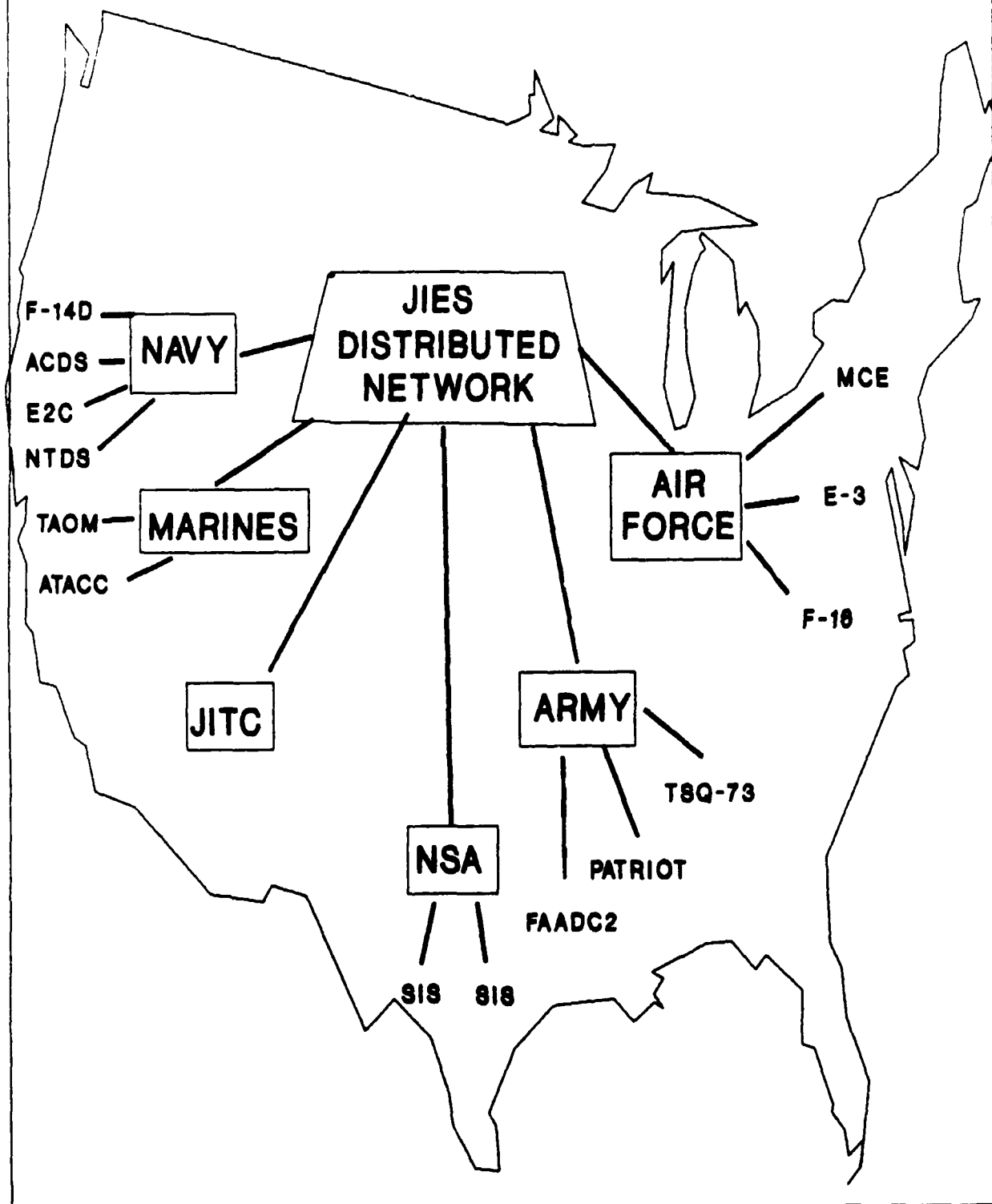
APPENDIX C-3

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TESTING TERMINOLOGY

DOD	US ARMY	USAF	JTC3A
DT&E	DT&E	DT&E	DT&E
OT&E	OT&E	OT&E	OT&E
	FOLLOW-ON OT&E	FOLLOW-ON OT&E	
		QUAL. OT&E	
COMBINED	COMBINED	COMBINED	COMBINED
OT&E/DT&E	OT&E/DT&E	OT&E/DT&E	OT&E/DT&E
MULTISERVICE	MULTISERVICE	MULTISERVICE	MULTISERVICE
PREPRODUCTION	PREPRODUCTION	PREPRODUCTION	
QUALIFICATION	QUALIFICATION	QUALIFICATION	CERTIFICATION
PRODUCTION	PRODUCTION	PRODUCTION	PRODUCTION
ACCEPTANCE	PROVEOUT	QUALIFICATION	ACCEPTANCE
	FOLLOW-ON		VERIFICATION
	PRODUCTION	SERVICE TEST	INTERFACE CERT.
	EARLY USER T&E		COMPARISON TEST
	FORCE DEVLOP.		TECHNICAL TEST
	CONCEPT EVAL.		VALIDATION/
	PROGRAM		REVALIDATION
	ON-SITE USER		OPER. EFF.
	TEST (OSUT)		DEMONSTRATION
	TECHNICAL		FEASIBILITY
	FEASIBILITY		PROCEDURAL
			INTERFACE
			TECHNICAL
			INTERFACE
			PRELIM SERVICE

APPENDIX D

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49.   The author has had several years experience testing/evaluating

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